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In the "Medical Record" for August 30, 1879, the writer described and demonstrated the applicability of a new form of splint for diseases of the joints, which he had a short time previously devised. It consisted of two terminal plates of thin copper, perforated upon the upper side and connected by a combined slotted bridge, elevated a short distance from the surface. This bridge consisted of two overriding slotted steel strips connected to a slotted steel sector by three clamps, as shown in Fig. 1.

It was maintained at the time that, on account of its simplicity, durability, and range of applicability, it would be found a useful splint in the various inflammatory conditions of joints.

This splint was afterward exhibited to the American Medical Association in 1881, and has been described more or less at length in several journals since that time.

Its usefulness and value have now been demonstrated by the experience of the intervening years, and it holds for itself in the surgical armamentarium a unique and permanent position.

It is not, however, the object of this paper more than casually to describe this splint, as its use is confined more

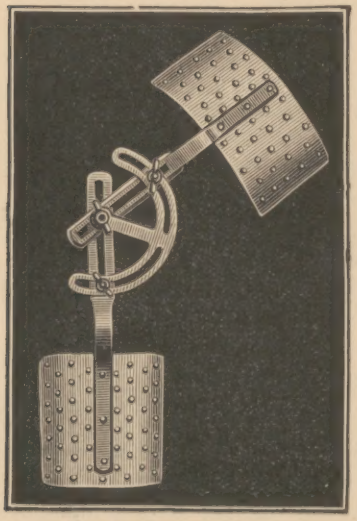

FIG. 1.—The sector splint.

FIG. 2.—Showing application of sector-bracket to knee.

to the treatment of acute inflammatory conditions of joints than to the chronic forms of joint disease which are to occupy our attention.

At the time of its introduction the principal point of value alleged for it was the ease with which *local* extension could be produced in a joint by the traction which the splint exerted in the axes of the limb. Taking the knee joint for example, we had at that time in orthopædic surgery but one splint which would allow this result to be produced; and this, while it produced a local extension of the knee, did not afford facilities for the proper fixation of the joint at the same time. The writer alludes to the splint

of Dr. H. G. Davis, a representation of which will be seen by reference to Fig. 3.

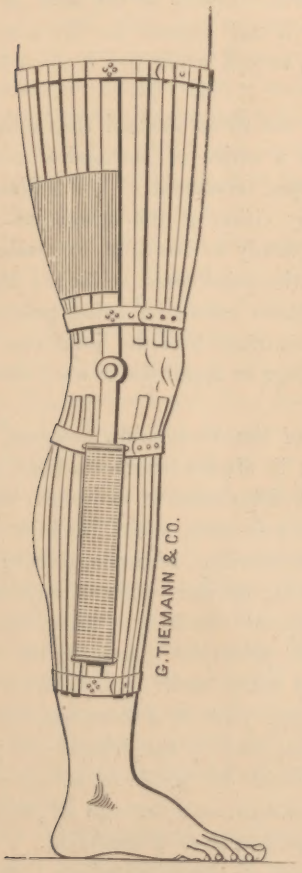

FIG. 3.—Dr. H. G. Davis's knee-joint local extension splint.

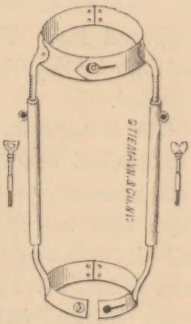

FIG. 4.—Sayre's knee splint.

FIG. 5.—Stillman's joint movement for fixation or motion.

We also had at this time the local extension splint of Professor Sayre.

Unlike Davis's splint, this, when the leg was flexed, exerted traction in the third side of the triangle, the two other sides of which were formed by the axes of the thigh and leg. Traction is not exerted in the axes of the limb by Sayre's splint, except when the limb is fully extended.

The sector splint which the writer devised thus fulfilled a mechanical condition, or a series of mechanical conditions, necessary to the proper treatment of joint disease, which were not fulfilled by either of the others just described, for, when applied firmly to the limb by plaster of Paris and adhesive plaster, the joint could be locked firmly in any position, with or without extension being produced at the same time, and the surface over the joint was left exposed for whatever dressings or applications were considered necessary.

In chronic conditions of the knee joint, however, the plaster-of-Paris attachment is always uncomfortable, and can not be removed without disturbance of the joint. Since the atrophic changes in the soft parts about the joint render frequent removal of the dressing desirable, it becomes almost a necessity to provide special forms of apparatus which can be removed whenever necessary. These should retain in their formation the principles governing the construction of the sector joint splint itself; in fact, the treatment of diseases of the knee joint, as a class, has, from a surgical standpoint, been impeded by the difficulty in procuring apparatus which could be used advantageously through all stages of the treatment, and through all possible conditions which might arise during such treatment.

One of the most important of these indications is to incorporate in the brace, and to place on either side of the joint (in its transverse pivotal axis), a movement which will allow of either fixation or motion.

In Fig. 5 such an one is shown,* and if the pivotal center is placed in the transverse pivotal axis of the joint, its arc of motion will correspond closely to the arc of motion in the normal joint, and by means of the clamp in the slotted arc the joint may be fixed in any desired position, or, by releasing the clamp slightly, motion may be allowed.

Another important indication is the occasional employment of traction, and a new feature in this splint consists in the method of obtaining it by having adhesive plaster grasp the knee just below and above the joint over a *very limited* area; and to effect this the plaster is cut in the fan-shape shown in Fig. 6 (*A*), and long strips of webbing are attached to each. It requires four of these fan-shaped pieces for each knee, and four long pieces of webbing; and these are to be placed as shown in Fig. 6 (*B*), interlaced for greater security from displacement, and then covered with roller bandage, as in Fig. 7. Upon the superior and inferior extremities of the splint are provided rollers and buckles, to which the webbing is to be attached, and then, by means of an elastic ratchet, force may be applied upon the thigh portion of the instrument to effect the extension (see Fig. 9).

This arrangement differs from any attachment in ordinary use at the present time in being limited to a small zone just above and below the joint, and consequently does not interfere with the muscular structure of the thigh or leg, as is the case when the splints are applied by adhesive plaster over the whole extent, as in other splints for this purpose, or in the plaster-of-Paris attachment formerly used by the writer.

To exert the traction and produce extension of the joint, the ends of the webbing strips are to be passed over the rollers at each extremity of the splint, and, after being pulled

* For description of this movement, see the "Boston Medical and Surgical Journal," August 31, 1882, p. 200.

upon as firmly as possible, are secured in the buckles provided for that purpose.

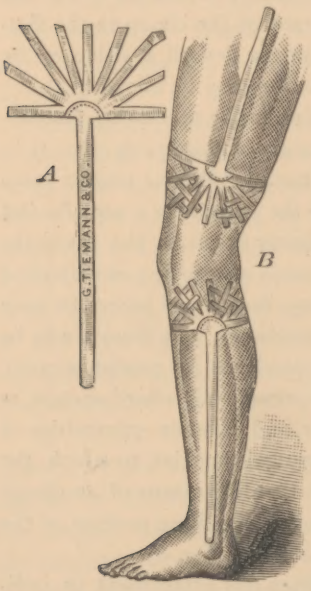

FIG. 6.—(*A*) Fan-shaped pieces of adhesive plaster, with webbing attached, for traction.
(*B*) The same applied to limb, interlaced.

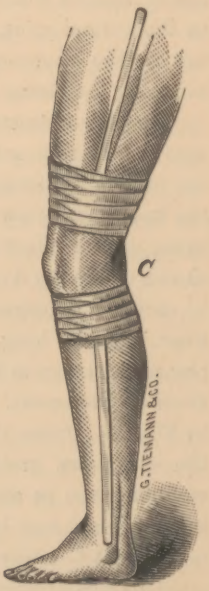

FIG. 7.—(*C*) The same covered with roller bandage, ready for the splint.

The upper thigh girth is then pushed away from the remainder of the apparatus by either elastic or rigid ratchets, as the surgeon prefers. The ratchet shown in Fig. 8 consists of two overriding slotted strips, which can be fastened together by a screw-clamp when sufficient traction has been exerted by the elastic strap provided for that purpose.

This form of ratchet is a modification of the original Davis elastic ratchet, and in the hands of the writer is more

effective than any other traction ratchet he has used, because, by simply loosening or tightening the clamp (the elastic strap being on the stretch at the same time), the traction may be varied from the elastic to the fixed at the will of the surgeon; but the writer has found that, if the elastic tension is kept up unvaryingly, the adhesive plasters are apt to cut into the skin in very much the same manner as and on the principle of an elastic ligature.

This is obviated, without impairment of the efficacy of the traction, by simply tightening the clamp holding the slotted strips together when the desired amount of extension of the joint is secured.

Another indication, also, of the utmost importance in the treatment of knee-joint disease is the prevention of posterior luxation.

Most of the diseases of the knee joint are accompanied by a tendency, even in the milder cases, to luxation of the tibia backward, and this is a feature which the mechanicians of orthopædic surgery have tried to overcome with more or less success.

To meet this indication, the author has devised a new and effective arrangement (see Fig. 8), which brings to bear a spring lever power which is distinct from anything heretofore used, and operates without interfering with the action of the remainder of the brace. It will be noticed that it is a long, flat steel bar, bent to conform to the back of the leg, and placed posteriorly. At its upper end is attached a semi-girth which presses on the back of the upper part of the leg, and below it is attached to a stirrup which is itself fastened to the lower girth of the instrument.

This stirrup is provided with a hinge and a socket, so that it may be opened and shut when the rest of the brace is in position, and the forward pressure, which is dependent upon the angle which the posterior lever makes with the

rest of the brace, can thus be adjusted by means of a ratchet at the intersection of the lever with the stirrup without the

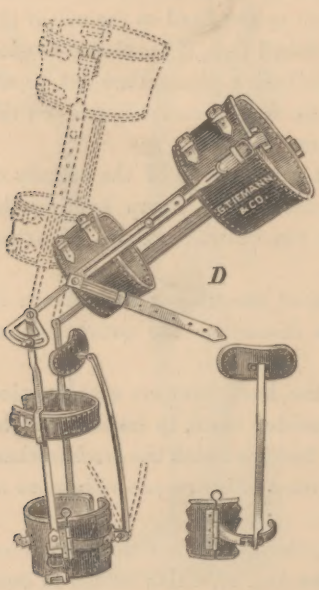

FIG. 8.—Stillman's knee splint.

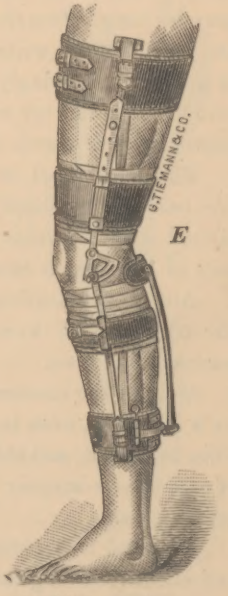

FIG. 9.—Stillman's knee splint applied.

necessity of removing the brace from the limb. One of the features of this arrangement consists in its availability for all classes of cases in which the least tendency to this subluxation exists, for it can be adjusted to any desired angle, thereby giving any degree of forward power, and this power is brought to bear precisely where it is wanted, and without causing impingement of the brace upon the limb at any point.

There are very few cases of joint disease, even of the simplest form and of the most recent date, in which the

comfort of the patient is not increased by having a certain amount of forward pressure just below the popliteal space.

How many of these patients say to the surgeon that they feel they could walk if they "had something that would press the leg forward just below the knee, as it seems weak at that point"! And by the arrangement shown this power can be supplied without interfering with the main portion of the brace or with the motion of the joint.

There is no form of knee-joint disease in which this forward pressure, in either a lesser or greater degree, is not of advantage; and there is an anatomical reason for this, since in these diseases relaxation of the quadriceps extensor femoris is accompanied by a contraction of the antagonist flexor muscles, the biceps, semi-membranosus, and semi-tendinosus, thus interfering with the possibility, in many cases, of producing linear traction in the proper axes of the thigh and leg; while, if the tibia is held forward in the position it would have if the anterior muscles were exerting their normal power, the extension of the joint is effected without pain to the patient, and the traction is exerted in the proper direction.

By means of a ratchet at the intersection of the inferior extremity of the posterior lever and the stirrup to which it is attached, this power, as has been stated, can be adjusted so that the lever can be varied from a mere upright support to a spring lever of tremendous force, and in every case in which it is applied (provided, of course, that the power exerted is not beyond the proper amount necessary for the particular case) the patient's usual comment is that the comfort of the apparatus is thereby much increased; and from a surgical standpoint the joint is placed in much better condition for curative treatment, because this tendency to backward luxation is greatly overcome.

After traction has accomplished its purpose and ex-

tension of the joint is no longer necessary, the splint is so arranged as to permit the removal of the rollers and buckles at each extremity and of the traction ratchets, thus converting it into an effective simple fixation splint or knee support during the stage of convalescence, when by the use of restorative measures the anterior muscles of the thigh have been strengthened so as to hold the tibia forward in its proper axis with the femur.

In Fig. 10 is shown a brace which differs from the one just described only in the greater lateral support afforded the knee by the use of two larger sector movements opposite the joint. There is also frequent occasion to force the sides of the brace as closely against the joint as possible in

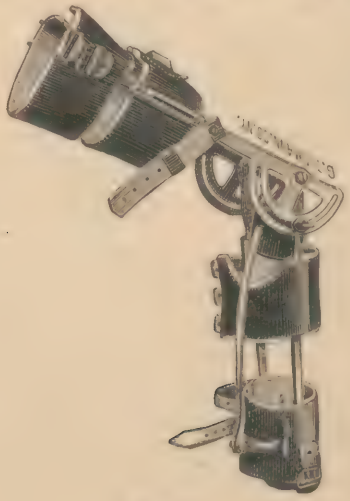

Fig. 10.

order to afford protection from lateral displacement, and to effect this the knee is spanned anteriorly by a metallic band sufficiently raised not to touch the surface. This band is

divided in the center anteriorly and the two ends are connected by a screw which draws them nearer together or forces them farther apart, as desired.

This brace is shown in Fig. 11, and perhaps will be still better understood by reference to Fig. 12, which illustrates it as applied upon the limb. So far, the braces shown are used in connection with crutches and a raised shoe, but in con-

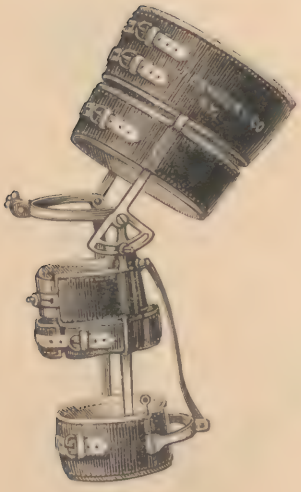

FIG. 11.

FIG. 12.

valescence, when the weight of the body can be borne without pain, and yet protection of the joint is desired, the side-strips of the brace are frequently extended below the foot, being attached to the shoe underneath the arch by a pivot

to allow of the natural movements of the foot, and jointed opposite the ankle on either side, as shown in Fig. 13. Another very good convalescent brace, to be used when it is desired to keep the weight of the body off the affected joint

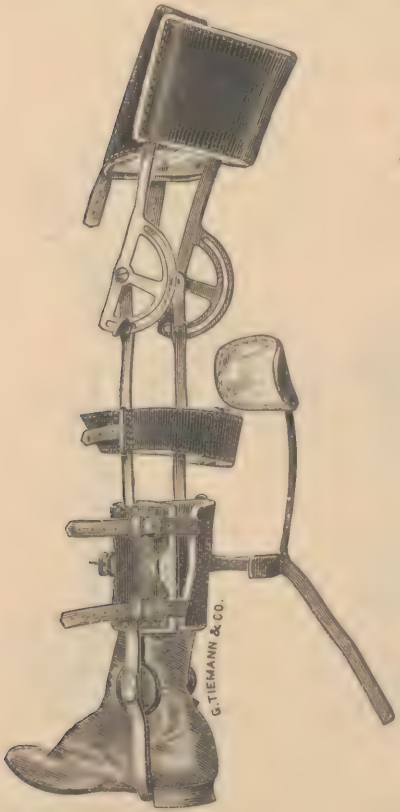

Fig. 13.

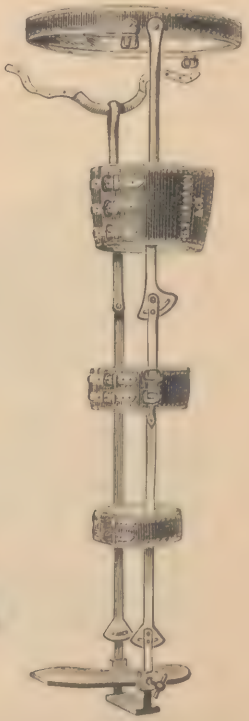

Fig. 14.

and yet permit locomotion, is shown in Fig. 14, in which the side-strips terminate superiorly in a hip-band and peri-

neal crutch, and inferiorly in a heel-plate, sector joints being provided at the knee and ankle for regulating the movements of those joints; but such an apparatus is rarely required.

It is the province of the orthopædic surgeon, and not of the instrument-maker, to decide the form of brace adapted to each special case, and the more thoroughly the profession becomes familiar with this idea and practices it, the fewer will be the failures which so frequently attend the mechanical treatment of chronic disease of the knee joint.

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